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COUNTDOWN ACID RAIN

Ontario's Acid Gas Control Program for 1986-1994

Environment
Ontario
Jim Bradley, Minister

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INTRODUCTION

All industrial activities cause pollution. The challenge is to drive the pollutants below the level at which significant environmental damage occurs. Ontario's Acid Gas Control Program is designed to move towards that goal.

We are taking aim at two polluting gases, sulphur dioxide and nitrogen oxide.

Sulphur dioxide (SO_2) is produced mainly by non-ferrous smelters, coal-burning power plants, and iron ore sintering. Pulp mills, refineries, and many other smaller sources add to the problem.

Oxides of nitrogen (collectively called NO_x) are emitted by automobiles and other vehicles, coal-burning power plants, and high-temperature combustion where some of the nitrogen in the air is burned.

Although SO_2 and NO_x are both serious problems, Ontario's new package of emission controls is concerned mostly with SO_2. Environmental studies have proven that the sulphate deposition resulting from SO_2 emissions is the primary cause of surface water acidification. Damage from nitrogen oxides and nitrate deposition is not as well documented but we are moving to reduce NO_x emissions as well. The federal government will apply tighter NO_x standards to automobiles, effective with the 1988 model year. Ontario's major abatement action on NO_x is a regulation passed in 1981 which places a cap on NO_x emissions from coal-fired power plants.

During the 1970s, the governments of North America were preoccupied with local or "ambient" air quality. During this period, SO_2 emissions in Ontario were cut in half, as provisions under the Environmental Protection Act forced the use of abatement technology on the polluting sources.

In the United States, passage of the Clean Air Act provided a similar network of rules and regulations aimed at protecting local air quality. Some states reduced their total SO_2 and particulate emissions as a by-product of safeguarding their cities and areas near major pollution sources (while other states had dramatic increases in emissions).

The concern about protecting local air quality remains important. Ground level concentrations of SO_2 and particulate matter are of particular concern with respect to protecting human health. But these standards were never designed to protect the natural environment from the slow accumulation of acidic deposition. In fact, the decision to build tall stacks in the 1970s to disperse the pollutants reduced the local air pollution burden by adding to the problem of the long-range transport and deposition of acid compounds. Instead of reducing emissions, we merely exported the effects.

There is an obvious linkage between local air quality and long-range transport of air pollutants because a reduction of emissions will affect both. However, legislation and rules designed for the protection of local air quality are neither appropriate nor sufficient to deal with pollution on a regional or continental scale.

In recognition of this shortcoming in historic legislation, Ontario was the first jurisdiction in North America to require SO_2 reductions from companies already in compliance with ambient air quality regulations. The concept was designed specifically to deal with the long-range transport/acid rain problem, as distinct from ongoing limitations on the allowable concentrations of pollutants in air near the source. Inco and Ontario Hydro were the first recipients of the new type of emission limits in 1980-82.

Ontario is now taking significant further steps to curb the long-range transport of SO_2. Province-wide emissions of SO_2 will be cut to 885 thousand metric tonnes by 1994, compared to the 1980 base case value of 2,194 kilotonnes.

The package of emission controls has been designed to allow for normal production levels, so that economic activity will not be inhibited. Consultation has taken place with each of the major pollution sources to ensure that the government is not demanding the impossible, although in most cases, considerable technological development is still needed.

At the same time, a commitment is being made to vigorously enforce the new regulations, and a package of economic penalties and incentives is being developed to make it more profitable to reduce emission levels than to continue them.

The economic system demands metals, electricity, paper, petroleum products and means of transportation. But it is not necessary to accept the levels of pollution which currently result. The polluters must accept their responsibility to deal with the by-products of their activities.

We are helping ourselves by cutting back on air pollution, but it is notable that the emission reductions specified for Ontario will reduce wet sulphate deposition by 7.8 per cent in the Adirondacks, 7.1 per cent in New Hampshire, and by lesser amounts at other receptor sites. We hope this will spur our American neighbours to demand further action from their own state and national governments so that they in turn will reduce the 50 per cent of our deposition coming from the United States.

Physical Damage Caused by Sulphur Dioxide

The primary cause of lake acidification in central Ontario is the deposition of acid derived from man-made emissions of sulphur dioxide. In large areas of the province which embrace Canada's precambrian shield, the quartzite or granite-based geology and thin soil provide inadequate buffering capacity to neutralize the acid falling from the sky. Gradual decreases in lake water pH are accompanied by periodic short-term acidification episodes as a result of spring snow-melt and heavy rains.

A survey of 5,341 lakes in Ontario has found that 4 per cent (220 lakes) are already acidified, 13 per cent are extremely sensitive and 38 per cent are moderately sensitive to acid rain. When projected to all of Ontario's lakes, it is estimated that at least several hundred lakes have been acidified and tens of thousands are experiencing biological damage.

The effects on aquatic life are primarily a result of the combined toxic effects of acid and aluminum which is leached from the rocks and soil by the increased flow of acid.

Acidification of lakes results in changes or decreases in phytoplankton, zooplankton, fish and frog species and, as a consequence, the disappearance of wildlife that feed on aquatic life.

Aside from the disappearance of some or all species of fish, recreational waters can be severely affected by a very foul-smelling type of algae associated with the deposition of sulphur compounds.

Types of filamentous algae, which form in large unpleasant masses in shoreline areas of lakes, have been associated with lower pH in the water. This can be reversed if the water becomes less acidic.

These damages have only been observed in sensitive areas receiving high levels of acid deposition. From such observations it has been determined that all but the most sensitive aquatic systems can withstand a deposition level of 20 kilograms of wet sulphate per hectare per year (18 pounds per acre). This "target loading" has formed the basis of the SO_2 emission reduction program to date. The target loading is presently exceeded in all of central and southern Ontario.

Studies of lakes in the Sudbury area have proven that acidification can be reversed by reducing sulphate deposition. Therefore, we have complete confidence that the new control program will be of benefit to Ontario's lakes and streams. Full protection would require comparable control action in the U.S.A.

Dramatic forest die-back and reduced tree-growth have been documented in parts of Europe and in North America. The exact role of sulphur dioxide is not yet known, but scientific research suggests possible mechanisms are direct attack of gaseous SO_2, damage to foliage and roots by acid deposition, the mobilization of metals in the soil and leaching of nutrients from the soil and vegetation. We believe that the SO_2 control program, which is essential for protection of surface waters, will also provide some protection to our forests, especially in combination with our NO_x control actions.

Pollution from SO_2 and its oxidation products contributes to the rapid weathering of historic buildings, statuary and native Canadian rock painting, as well as causing ongoing damage to building materials and paint. Although modifications can be made to architectural designs and preventive measures taken, the cost is considerable, and the long-term effectiveness is not well known.

Sulphur dioxide, in combination with particulates, is known to cause respiratory health problems, especially for persons who have chronic lung ailments. In several cities, Ontario has established an Air Pollution Index based on a combination of these two pollutants. The provincial Environmental Protection Act gives the Government the power to order temporary cut-backs of emissions (through reduced operations) when the Index reaches alert levels. Through abatement efforts over the past 15 years, local sulphur dioxide and particulate levels have been reduced to the point where Index alerts are now infrequent occurrences in Ontario.

Sulphates (oxidation products of sulphur dioxide) exist in the air as fine particulates. Sulphates are often transported long distances in association with ozone. Sulphates and ozone also cause respiratory problems, particularly for individuals with asthma. The impacts of sulphate-ozone concentrations on asthmatic children are currently under study.

Physical Damage Caused by NO_x

Nitrogen oxides are created during high-temperature combustion by chemical reactions at the site of combustion and from burning of nitrogen compounds contained in coal and other fuels. They are a causative factor in the creation of ozone, which is known to cause direct injury to human health and vegetation.

Nitrogen oxides are converted to nitric acid which corrodes metals and other building materials, and contributes to "spring pH depression" of lakes and streams at the time of snow-melt.

Characteristic damages to forests, such as thinning of the canopy, decreased growth and death of trees are being reported from many areas of North America and Europe. The effects are observed in several species including sugar maple, red spruce, beech, pine and ash and in all age groups. There seems to be little, if any, evidence that these phenomena occur in areas not affected by air pollution and not receiving elevated acid deposition such as Northern Sweden and Norway and Northwestern Ontario. Sweden recently reported that the locations of forest damage correspond to the area of surface water acidification.

Scientific consensus has been reached in the Federal Republic of Germany that air pollution is a causative factor in forest damage, and that country is moving to control emissions of SO_2 and NO_x although the exact cause/effect relationships are not known. The West Germans are enforcing their new abatement measures out of a sense of desperation, and in that sense the onus of proof has been shifted to the polluters, who must now demonstrate that their particular pollutants are not causing forest die-back.

There are several theories of how air pollution may be causing damage. The "shoots theory" says that leaves are first damaged by ozone which increases the rate of nutrient leaching. This is aggravated by the acidity of the rain. Nitrogen oxides are implicated both in their role of contributing to the formation of ozone and in contributing to the low pH of the rain. Sulphate is also implicated in the low pH of the rain.

The "roots theory" says that the fine roots are damaged by low pH in soil water, so they are unable to take up sufficient nutrients. Sulphate is a major cause of acidification of soil water but nitrate contributes as well.

At the recent International Symposium on Acidic Precipitation in Muskoka, there was a scientific consensus that greater emphasis will have to be placed on NO_x control in all countries.

Economic Impacts of Acid Rain

Since 1982, the Ministry of the Environment has conducted a number of studies which have attempted to assess the economic impact of acid rain on tourism, agriculture, forestry, commercial fishing, commercial trapping and hunting, as well as the value of damages to buildings and other materials. While the results of those studies are not conclusive, they indicate the possible consequences of continued acid deposition.

For example, sport fishing is the main recreational activity threatened by acidification. Fish populations are especially vulnerable to acid rain, and sport fishermen spend about $265 million each year in Ontario, or about 29 per cent of the $917 million Ontario earns from aquatic-based tourism annually (expressed in 1980 dollars). Further, the acidification of lakes which has already occurred probably reduces spending on sport fishing by about $4.1 million per year in both direct and indirect expenditures. If these lakes could be reclaimed, most of this spending would occur in the Parry Sound-Muskoka-Haliburton region, and in the north-eastern part of the province.

However, if acidification continues, future losses to these areas of the province could be much higher. For example, if acidification of lakes ultimately caused a four per cent reduction in fish populations, the reduced expenditure could be as much as $21 million per year. Under a "worst case scenario" in which fish populations declined by 20 per cent of current levels, the reduction in tourism revenues in the affected regions could be as high as $70 million per year.

For other resource sectors, the biophysical effects are the subject of strong debate and the estimates of the monetary values associated with these effects are uncertain. Nevertheless, the value of increased costs or decreased revenues linked to effects on forestry, commercial fishing and replacement and repair of buildings and other structures does provide a minimum estimate of the social and economic importance of these effects to Ontario.

Estimates to date indicate that the extra costs and reduced revenues which could result from acid rain may amount to as much as $400 million between 1980 and 1990. Moreover, many of these effects would be felt in parts of the province which already face economic and social difficulties.

These estimates represent the extra costs or reduced revenues due to the effects of acid rain in commercial activities only – that is tourist operators or logging companies. They make no provision for the intangible but very real value of reductions in the sense of satisfaction and enjoyment that individuals may experience. Whatever monetary value is assigned to the "amenity value" of a cleaner environment, that value must be added to the value of the reduced damages that could result from acid rain control programs.

A survey – conducted to determine how strongly people feel about acid rain, how seriously they regard it, and how much they would be willing to pay through increased taxes and prices to reduce it – showed that 97 per cent of the total sample, had heard of acid rain, and 73 per cent said it is a serious problem. Over 75 per cent of the respondents agreed, or agreed strongly with the following statements:

- protecting the environment is so important that the requirements and standards cannot be set too high;
- the Ontario Government is much too soft on companies which pollute the environment;
- protecting the environment is so important that continuing improvements must be made regardless of cost.

In addition, 83 per cent of the respondents disagreed or disagreed strongly that "we must relax environmental standards in order to achieve economic growth", and almost 75 per cent said they would be willing to pay higher taxes and prices to prevent further deterioration of the environment from acidification.

The Cost of Abatement

On March 6, 1984, Federal and Provincial Ministers of the Environment agreed to reduce Canadian annual emissions to 2.3 million tonnes by 1994 (50 per cent of the 1980 base case). Ontario is committed to a sizeable reduction.

Many people are concerned about the economic effects of spending millions of dollars on SO_2 emission reductions. However, the money spent on abatement programs does not disappear down some black hole. It is paid to companies who hire employees, buy parts from suppliers, pay taxes, and generally contributes to the economic activity of the province and the nation. Abatement results in higher capital and operating costs to the companies and utilities (and to their customers, because some of these costs are eventually passed along in higher prices). Nonetheless, these costs do not represent a loss to society at large but rather a re-direction of money into investments that produce a cleaner environment for everyone. In fact, according to most studies, major pollution control expenditures could result in an increase in employment. Furthermore, economic research to date has indicated that the amount of SO_2 abatement being sought from emitters in Canada and the U.S. will not impose undue cost burdens or economic disruptions on individual firms, industrial sectors or particular regions.

Nevertheless, a major abatement effort will require some sacrifices for our present generation. However, not implementing an abatement program could result in the sacrifice of part of our environmental heritage for our children as well as ourselves.

Federal-Provincial Agreements

As a result of the fact that negotiations with the United States failed to produce an international SO_2 control program, the Federal-Provincial Environment Ministers in March 1984 decided to take unilateral action to cut SO_2 emissions east of the Manitoba-Saskatchewan border.

They announced reductions of 50 per cent from the "1980 base case", to a level of about 2.3 million tonnes of SO_2 per year by 1994. Comparable action by the U.S. would enable realization of the deposition target of 20 kg/ha·yr of wet sulphate, considered sufficient to protect all but the most sensitive aquatic systems.

The allocation by industry and province was to be worked out later.

On February 5, 1985, the Environment Ministers reconvened in Montreal and announced the allocation of most of the reductions needed to meet the 2.3 million tonne target, as follows:

TABLE 1

Province	1980 Base Case (tonnes)	Reductions (tonnes)	Emission Objectives (tonnes)
Manitoba	738,000	188,000	550,000
Ontario	2,194,000	1,164,000	1,030,000
Québec	1,085,000	485,000	600,000
New Brunswick	215,000	30,000	185,000
Prince Edward Island	6,000	1,000	5,000
Nova Scotia	219,000	15,000	204,000
Newfoundland	59,000	14,000	45,000
TOTAL:	4,516,000	1,897,000	2,619,000
To be apportioned:		319,000	2,300,000

On March 6, 1985, the federal government announced that up to $150 million had been committed for smelter modernization and pollution reduction to help meet the 2.3 million tonne ceiling. The allocation of this new money to smelters in eastern Canada was to be negotiated.

The process which was set in motion by the federal-provincial meetings and agreements has continued, and this report outlines the actions being taken within Ontario. The new program will exceed the previous commitment.

Ontario's New Package of Emission Controls

About 80 per cent of Ontario's SO_2 emissions come from only four corporate sources. Consequently, the new package of controls concentrates on the "big four", although smaller point sources are also being squeezed down by a combination of specific controls, a new general boiler regulation, and a shift in the relative price of fuels.

Canadian and U.S. scientists agreed on 1980 as the "base year", so the SO_2 regulations are measured from this date. Since 1980, all Ontario SO_2 sources have met the regulated limits which had been imposed.

The new legal limits, and their dates of implementation, are compared with the previous legal limits in Table 2.

TABLE 2

Ontario's New Package of SO_2 Emission Controls
Legal Limits and Effective Dates
(thousands of metric tonnes per year)

	1986	1990	1994
Ontario Hydro			
– Current	390	260	
– New	370	240	175
Inco			
– Current	728		
– New	685	*	265*
Falconbridge			
– Current	154		
– New	154	154	100
Algoma (Wawa)			
– Current	285		
– New	180	180	125
Other Sources**			
– Current	235	227	
– New	235	227	220
			885

*See the section on page 7 for detail on new Inco Regulation.

**Some of the smaller sources will not have new specific limits imposed upon them, but their emissions are expected to decrease as shown.

More details about each of the four major SO_2 polluting sources are shown in the following sections.

Ontario Hydro

This public utility, owned by the Province of Ontario, operates three coal-fired plants in southern Ontario, as well as smaller plants in the northwest, at Thunder Bay and Atikokan. Other fossil-fuel plants are now mothballed, but will probably be brought back on line in the 1990s as demand for power increases.

In 1984, electricity was produced about equally from water, coal and nuclear plants, with coal used as the peaking and reserve fuel. As more nuclear plants come on stream between now and 1992, coal use will decline until the mid-1990s. After that, the projected increased demand is expected to require increasing use of coal as the fossil-fuel plants are brought back into use.

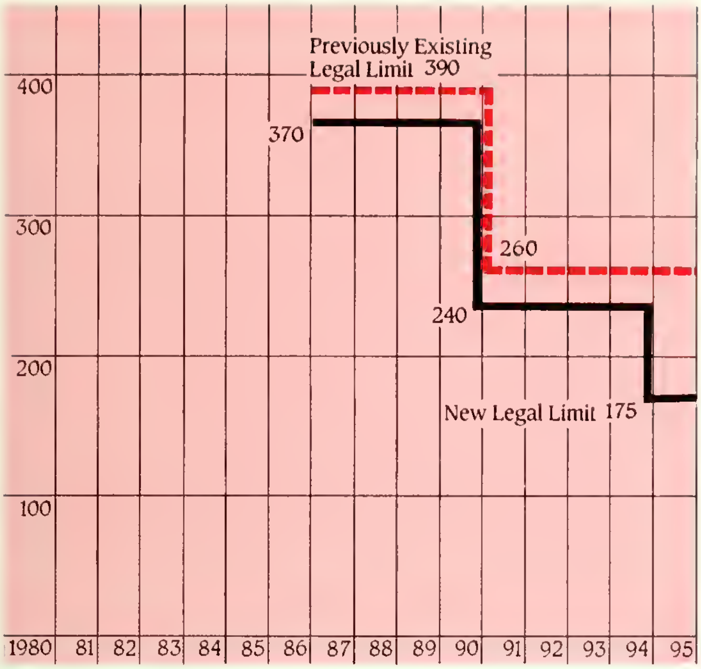
A specific regulation was placed on Hydro in 1981 (now O. Reg. 8/82), to come into effect in two steps. It required a province-wide emissions cap of 390 kilotonnes of sulphur dioxide per year by 1986, reduced to 260 kt/yr by 1990, regardless of the amount of fossil fuel burned. Oxides of nitrogen were limited at the same time.

These limits were established specifically to combat the acid rain problem, and are superimposed upon the ambient air quality standards, which remain in force.

The new legal limits tighten the screws, both in quantity and timing. The 1986 SO_2 limit is reduced from 390 kt to 370 kt/yr, the 1990 limit is reduced from 260 to 240 kt/yr, and a new maximum of 175 kt/yr is established for 1994 and thereafter. Over the ten-year period 1984 to 1994, SO_2 will be cut from an actual level of 444 kt to a legal limit of 175 kt, with regular mandatory reporting to show the steps being taken.

Figure 1

Ontario Hydro – Sulphur Dioxide Emissions
(thousands of metric tonnes per year)



Technology and Cost

The new regulations package, as a matter of policy, does not specify the methods Hydro must use to meet the emissions limits, but the tight timetable ensures that proven equipment must be installed soon. A requirement for regular progress reports will also provide assurance that the emission limits will be met on schedule.

Proven methods of removing SO_2 are in use, so the required emission reductions are known to be possible. However, the capital and operating cost of abatement could be greatly reduced by the development of new or improved technology, and some of the problems of the waste residues from scrubbers might be ameliorated. Research and development programs now underway in Canada and elsewhere will likely provide cheaper and better solutions than are now available.

Among the possible technologies are wet and dry scrubbing (which are in place), the use of particle-beam or ultra-violet devices on the stack gases, and lime injection multi-stage burners. Expanded use of low-sulphur coal could be combined with sulphur removal technologies if required.

Inco

Inco's Sudbury smelter operations have been the largest point source of SO_2 emissions in North America for some years, although they are exceeded by clusters of coal-fired power stations in several states in the U.S.

SO_2 emissions were cut by 59 per cent between 1970 and 1980 in response to increasingly tighter controls based on local air quality. Reductions in operating levels are still required on an episodic basis to prevent local fumigation when weather conditions are unfavourable for dispersion of the SO_2.

In 1980, new emission limits were established specifically to deal with the long-range transport/acid rain problem. Total allowable SO_2 emissions were reduced in steps to a level of 728 kt/yr, effective in 1983. Actual emissions in 1984 were under the limit, at 683 kt, and were running at about the same rate in the first ten months of 1985.

In April 1985, the Chairman of Inco announced that the company would cut its SO_2 emissions in half, to a level of 350 kt/yr by 1994. The new government package of regulations requires further reductions.

Effective in 1986, the total regulated SO_2 limit will be cut from 728 kt/yr to 685 kt/yr. The limit will be further reduced to 265 kt/yr, effective in 1994. Inco must provide semi-annual progress reports leading to a final report no later than December 31, 1988, showing exactly what technology and design will be employed, and how much it will cost.

In addition, an even tighter objective has been set at 175 kt/yr. Inco's December 1988 report must describe in detail the technology and design which could be used to meet this lower objective and its cost.

Provision is also made for the possibility of interim reductions between now and 1994. Inco's report must show the feasibility of cutting emissions to 525 kt/yr by 1990, and whether further reductions can be made earlier than 1994.

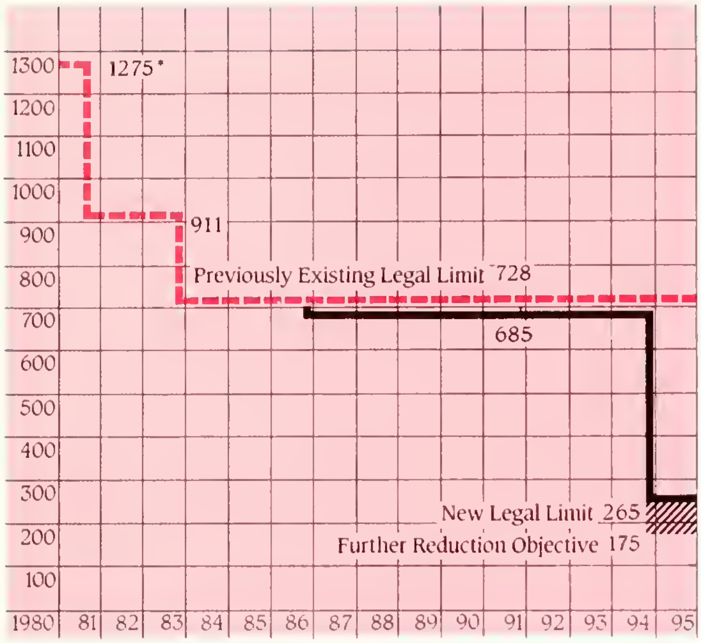
It is recognized that the level and timing of the abatement targets may be technically possible but beyond the ability of Inco to pay. Consequently, the new regulation provides that Inco must show the costs at each abatement level in its December 1988 report. If the provincial cabinet decides, after examining the evidence, that any of the emission levels are technically feasible but economically beyond the company's reach, it may provide public funds to make up the difference.

After 1988, when the final emission target and the interim steps have been determined, Inco is required to submit reports every six months on progress made in implementing the SO_2 abatement program. This will provide an opportunity to the government and the public for an ongoing review of the steps being taken.

Plant modifications will also require Inco to apply for Certificates of Approval from the Ministry of the Environment. This procedure will alert ministry officials as to any process changes which might preclude more desirable approaches to the emissions problem.

Figure 2

Inco Sudbury Complex – Sulphur Dioxide Emissions
(thousands of metric tonnes per year)



*Average limit for 1980 is 1158 kt

Technology and Costs

Inco has a number of options under intensive research and development, to be completed by the end of 1988. Known technology could be put in place to meet the new emission limits, but options which result in lowest cost, combined with the greatest possible degree of smelter modernization, are clearly preferred. This will provide a clean and modern smelter, while protecting jobs and the community.

Previous work by the Ontario/Canada Task Force on Inco and Falconbridge had indicated that two major and distinct SO_2 abatement steps could be taken, centred on the nickel circuit and the copper circuit respectively. This might still be the chosen route. But recent research work by the company suggests that other options could prove to be economically preferable, while still meeting the new SO_2 emission targets.

With respect to the costs, the basic government position is that the polluter should pay for necessary emission reductions.

But in the current economic situation, with depressed world-wide nickel prices and a reduced cash flow for Inco, assistance may nevertheless be required in order to accelerate the abatement program. The fragile environment cannot wait for improved profits in the smelting industry.

As a consequence of the federal-provincial acid rain agreement, Ottawa is providing a fund of up to $150 million for the modernization and emission controls for the Canadian smelting industry. Discussions are continuing as to the exact allocation of these funds. More precise information as to Inco's needs will flow from the December 1988 technical report which is required by the new Ontario regulation.

Falconbridge

Emissions of SO_2 from the Sudbury smelter of Falconbridge Ltd. were reduced by 64 per cent between 1970 and 1980 in response to a series of tighter local air quality controls. In 1978-80, the company modernized its smelting operation by installing new fluid bed roasters, electric furnaces and an acid plant. Consequently, it has been able to operate well under the existing SO_2 emission limit of 154 kt/year, although part of the reduction has been due to lower production levels resulting from depressed markets.

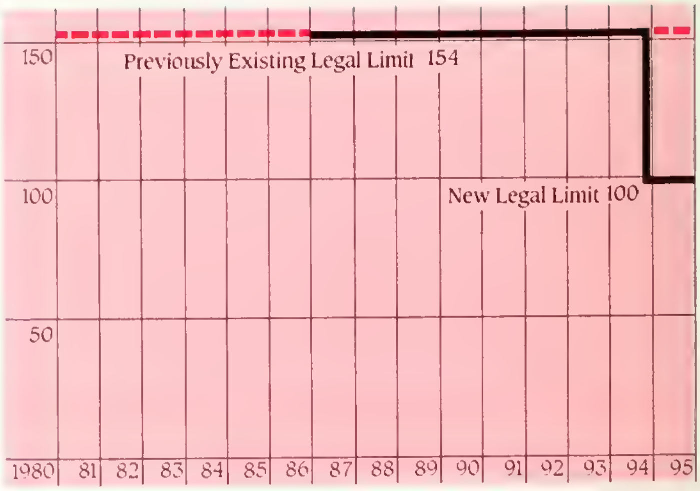
The new abatement package will require Falconbridge to reduce its Sudbury SO_2 emission level from 154 kt/yr to 100 kt/yr by 1994.

Falconbridge is required by December 31, 1988, to report to the ministry on the best available technology and design needed to meet the required limit. The company must also show the costs of the changes, and the provincial government will then decide whether to help pay for them, in a procedure similar to that applied to Inco.

After 1988, Falconbridge is required to submit progress reports every six months showing how the abatement plan is being implemented.

Figure 3

Falconbridge – Sulphur Dioxide Emissions
(thousands of metric tonnes per year)



Technology and Costs

The best means of reaching the new SO_2 emission limit appears to be a combination of pyrrhotite rejection from the ore, an increased degree of roast, and an improved converter slag system.

Active research is underway on all three elements of the emission reduction program with company funds provided through existing programs. The technical ability of the company to meet the new required emission limit is not in doubt; the lowest-cost method is also being sought.

A portion of the capital costs required for abatement may come from the federal government's promised fund of up to $150 million for SO_2 control and smelter modernization.

As research and development work is completed, process or plant modifications will be subject to the Certificate of Approval process. This will provide a further opportunity for close scrutiny.

Algoma Steel – Wawa

The Wawa operation of the Algoma Steel Corporation Limited is an iron sintering plant with no emission abatement equipment. The plant is the mainstay of the town's economy. Ambient air quality has been controlled by limiting production when weather conditions are unfavourable for gas dispersion. A Control Order issued in 1971 and amended in 1973 limits total SO_2 emissions to 285 kt/yr.

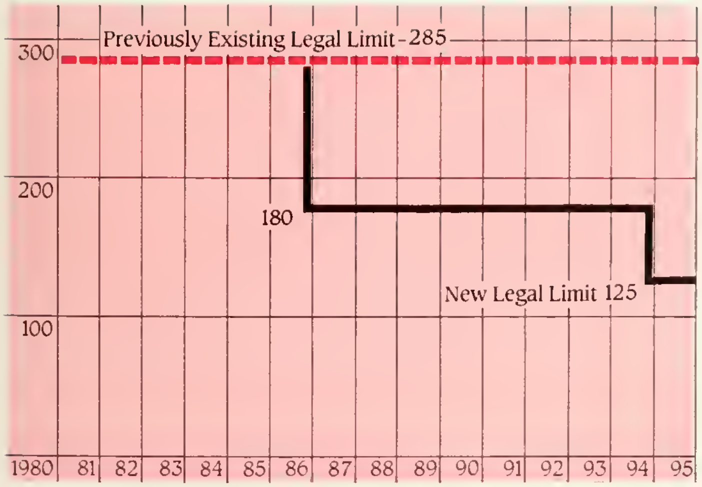
In recent years, the plant has been operating well below capacity and emitted 161 kt of SO_2 in the 1980 base year, but plans to increase production as markets allow.

The new package of abatement measures will require SO_2 abatement measures to be put in place, in addition to the existing ambient air quality controls. The legal SO_2 emissions limit will be reduced to 180 kt/yr effective 1986, and further rolled back to 125 kt/yr by 1994.

Figure 4 shows the previously existing Control Order limit and the new legal limit.

Figure 4

Algoma Steel, Wawa – Sulphur Dioxide Emissions
(thousands of metric tonnes per year)



Technology and Costs

Research and development work is already underway, including some in co-operation with the federal government. This involves a further separation of sulphur-bearing rock from the iron ore feed, by means of froth flotation.

A second significant means of reducing SO_2 emissions is the replacement of a portion of the ore feed with iron oxides produced as byproducts of other industrial processes, such as roll scale from steel plants. This is already being done on a limited basis and could be expanded. It would simultaneously help to solve a waste disposal problem and reduce SO_2 emissions.

Federal funds are already being used in research and development from the Industrial Research and Development Program. The capital cost for the required abatement measures could come in part from the federal government's promised $150 million fund for SO_2 emission reductions.

As in the case of other major emission sources, a strategy for meeting the new limits will be required in December 1988, with an interim status update every six months. Financial assistance will be considered following review of the technical feasibility and cost report.

Process modifications will also be subject to the Certificate of Approval process, which provides a further opportunity for close scrutiny.

Effects on SO_2 Emissions from Changes in the Price of Fuels

With the advent of higher oil prices in the early 1970s and because of Canada's dependence on foreign oil sources, the Federal Government initiated a program to promote a reduction in the use of oil (especially for home heating). This program emphasized energy conservation, home insulation, and switching to other fuels (natural gas, electricity, wood).

As a result of the decreased use of oil in eastern Canada, there has been a considerable reduction in SO_2 emitted from these multiple sources. Further decreases in SO_2 emissions from such sources will depend to some degree on the future pricing structures for oil, natural gas, and electricity in eastern Canada. However, during the next decade, emissions from "other sources" are expected to decline to a level of 220,000 tonnes.

New Boiler Regulation

In order to be able to maintain emissions of SO_2 at approximately 2.3 million tonnes in eastern Canada, it was deemed necessary to take some steps to limit emissions from new or modified sources of SO_2, in addition to the four major sources discussed above. Therefore, a new Regulation has been developed to limit SO_2 emissions from new or modified boilers by placing a 1 per cent sulphur content constraint on the fuel or by requiring that an equivalent amount of SO_2 be removed from the flue gas. (Ontario Hydro electric generator boilers and small boilers used for comfort heating are exempted.) The stipulations of this Regulation are in addition to those already in place which require emitters to meet the point-of-impingement ambient air quality standard.

The passing of this Regulation indicates that Ontario is serious about its intention to reduce and limit the emissions of SO_2 into the atmosphere.

Effects of the Canadian Control Program on Sulphate deposition

An examination of the predicted effects of the new Ontario control program clearly shows the importance of the emission reductions at home. Deposition of wet sulphate at the sensitive Muskoka site is reduced from the 1980 base case level of 32 kilograms per hectare per year to 27.6 kg/ha·yr in 1994. This is a 13.8 per cent reduction. Significant decreases in deposition also occur in many other sensitive areas. For instance deposition at the Quebec South site decreases by 10.1 per cent, and in southern Nova Scotia by 4.2 per cent. Decreases of 7.8 per cent may also be expected in the Adirondacks, and of 7.1 per cent in New Hampshire.

When the effects of reductions in other provinces are added to the Ontario control program, the expected deposition drops further, although most of the benefit occurs east (downwind) of Ontario. The Eastern Canadian control program will cut deposition by 19.9 per cent at the Quebec South site, by 8.4 per cent in southern Nova Scotia, and by 10.4 per cent in the Adirondacks and 17.5 per cent in New Hampshire, compared to the 1980 base case.

At the same time, it becomes abundantly clear that adequate environmental protection in Canada cannot be achieved without a serious abatement program in the United States. At many of the monitored receptor sites, deposition levels will still be well above the target level of 20 kilograms of wet sulphate per hectare per year, even after all the Canadian emission controls are in place.

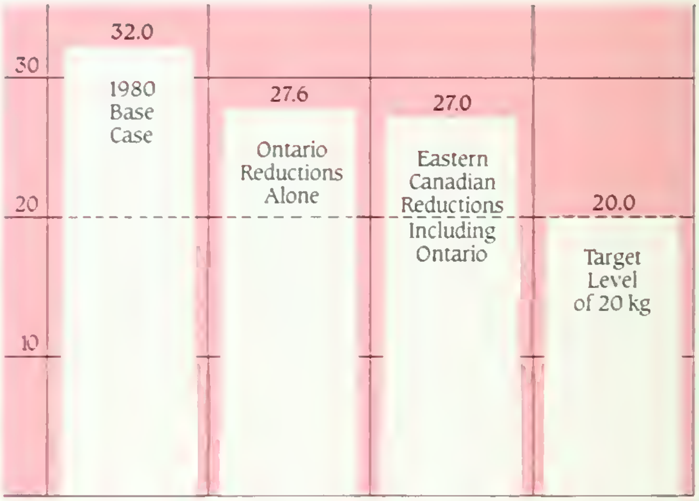
Even if Canadian SO_2 emissions were cut to zero, the target level could not be reached.

American control programs could take many forms, and it is not our business to suggest what the details should be. But it is clear that the target deposition level of 20 kg/ha·yr could be achieved by a serious U.S. abatement program.

As an example, the sensitive Muskoka site in Ontario is singled out in Figure 5. It shows the reduction in wet sulphate deposition resulting from Ontario's program alone, the reductions when the other provincial abatement programs are considered and the large gap between these measures and what is needed.

Figure 5

Effects of SO_2 Control Programs on Deposition of Wet Sulphate at Muskoka
(kilograms per hectare per year)



The target level of 20 kg/ha·yr is designed to protect all but the most sensitive aquatic systems from the effects of acid rain. If the United States takes significant action, this target could be reached.

Research and Monitoring

The need for the SO_2 control actions is well supported, but Ontario will be continuing its research program at the present intensive level.

Ontario has led in the field of environmental research on the effects of acid rain and it will continue to do so, through our own work as well as with the further cooperation with universities and many other agencies at the national and international levels. The nature of our research and monitoring is given in Ontario's Multi-Year Plan.

In implementing this new control program, a certain degree of uncertainty is recognized. Details such as rates of change of lake quality, effects of nitrogen deposition and human health effects will have to be monitored to determine the impact of the control program.

In order to successfully monitor the environmental response to this abatement program, Ontario will be entering into a formal agreement with the Federal Government to participate in the appropriate national monitoring programs.

COUNTDOWN ACID RAIN

ONTARIO'S ACID GAS CONTROL PROGRAM FOR 1986 - 1994

TEXT OF REGULATIONS

REVISED AUGUST 1987

ONTARIO REGULATION 660/85

REGULATION MADE UNDER THE ENVIRONMENTAL PROTECTION ACT

INCO SUDBURY SMELTER COMPLEX - 1994

1.-(1) Inco Limited shall not emit sulphur dioxide from its Sudbury Smelter Complex in the Regional Municipality of Sudbury on any day in any year after its emissions of sulphur dioxide in that calendar year exceed 685 kilotonnes.

(2) Inco Limited shall not emit sulphur dioxide from its Sudbury Smelter Complex in The Regional Municipality of Sudbury on any day in any year after its emissions of sulphur dioxide in that calendar year exceed 265 kilotonnes.

(3) Subsection (2) comes into force on the 1st day of January, 1994.

2. Inco Limited shall,

(a) perform such studies and research as are necessary to establish the best available technology and design, and the costs thereof, to assure that the emission limit referred to in subsection 1(2) is not exceeded;

(b) perform such studies and research as are necessary to establish the best available technology and design, and the costs thereof, to limit emission levels of sulphur dioxide to less than 175 kilotonnes a year;

(c) perform such studies and research as are necessary to establish the best available technology and design, and the costs thereof, to limit emission levels of sulphur dioxide to 525 kilotonnes a year by 1990 and further reductions before 1994; and

(d) submit written reports to the Minister by the 31st days of January and July in each year starting with the 31st day of July, 1986 to and including the 31st day of July, 1988 on the progress being made on the matters referred to in clauses (a), (b) and (c).

3. Inco Limited shall, by the 31st day of December, 1988, submit to the Minister a final written report of the studies and research referred to in section 2 in sufficient detail to enable the Lieutenant Governor in Council to assess,

(*a*) Inco Limited's corporate decisions on the economic and technical feasibility of,

(i) achieving emission levels of sulphur dioxide of 175 kilotonnes a year,

(ii) achieving some other specified level of emissions lower than the limit prescribed in subsection 1(2), and

(iii) meeting the limit of 265 kilotonnes prescribed by subsection 1(2);

(*b*) in the event that a limit or other level referred to in clause (*a*) is technically achievable but it is Inco Limited's corporate decision that it is not economically possible to achieve or meet that level, the financial assistance that Inco Limited would require to achieve that level; and

(*c*) the methods or plans proposed by Inco Limited to meet the emission levels referred to in clause 2(*c*) and in clause (*a*).

4. After the 31st day of December, 1988, Inco Limited shall submit semi-annual written reports to the Minister on the progress being made in implementing the methods or plans developed for purposes of this Regulation.

5. Regulation 301 of Revised Regulations of Ontario, 1980 is revoked.

Filed with Registrar
of Regulations: December 17, 1985

Published in
Ontario Gazette: January 4, 1986

ONTARIO REGULATION 661/85

REGULATION MADE UNDER THE ENVIRONMENTAL PROTECTION ACT

FALCONBRIDGE SMELTER COMPLEX - 1994

1.-(1) Falconbridge Limited shall not emit sulphur dioxide from its Smelter Complex in the Town of Nickel Centre in The Regional Municipality of Sudbury on any day in any year after its emissions of sulphur dioxide in that calendar year exceed 100 kilotonnes.

(2) This section comes into force on the 1st day of January, 1994.

2. Falconbridge Limited shall,

(*a*) perform such studies and research as are necessary to establish the best available technology and design, and the costs thereof, to assure that the emission limit referred to in section 1 is not exceeded;

(*b*) perform such studies and research as are necessary to establish the best available technology and design, and the costs thereof, to achieve such other lower sulphur dioxide emission levels as are economically and technically feasible; and

(*c*) submit written reports to the Minister by the 31st days of January and July in each year starting with the 31st day of July, 1986 to and including the 31st day of July, 1988 on the progress being made on the matters referred to in clauses (*a*) and (*b*).

3. Falconbridge Limited shall, by the 31st day of December, 1988 ,submit to the Minister a final written report of the studies and research referred to in section 2 in sufficient detail to enable the Lieutenant Governor in Council to assess,

(*a*) Falconbridge Limited's corporate decisions on the economic and technical feasibility of,

(i) achieving some specified level of emissions lower than the limit prescribed in section 1; and

(ii) meeting the limit of 100 kilotonnes prescribed by section 1;

(b) in the event that the limit or other level referred to in clause (a) is technically achievable but it is Falconbridge Limited's corporate decision that it is not economically possible to achieve or meet that level, the financial assistance that Falconbridge Limited would require to achieve that level; and

(c) the methods or plans proposed by Falconbridge Limited to meet the emission levels referred to in clause (a).

4. After the 31st day of December, 1988, Falconbridge Limited shall submit semi-annual written reports to the Minister on the progress being made in implementing the methods or plans developed for purposes of this Regulation.

Filed with Registrar
of Regulations: December 17, 1985

Published in
Ontario Gazette: January 4, 1986

ONTARIO REGULATION 281/87

REGULATION MADE UNDER THE ENVIRONMENTAL PROTECTION ACT

ONTARIO HYDRO

1. Emissions of sulphur dioxide and of nitric oxide from the fossil-fuelled electric generating stations of Ontario Hydro shall not exceed, in the aggregate, 430 kilotonnes in 1987, 1988 or 1989.

2. Emissions of sulphur dioxide and of nitric oxide from the fossil-fuelled electric generating stations of Ontario Hydro shall not exceed, in the aggregate, 280 kilotonnes in 1990, 1991, 1992 or 1993.

3. Emissions of sulphur dioxide and of nitric oxide from the fossil-fuelled electric generating stations of Ontario Hydro shall not exceed, in the aggregate, 215 kilotonnes in any year after 1993.

4. Emissions of sulphur dioxide from the fossil-fuelled electric generating stations of Ontario Hydro shall not exceed, in the aggregate, 370 kilotonnes in 1987, 1988 or 1989.

5. Emissions of sulphur dioxide from the fossil-fuelled electric generating stations of Ontario Hydro shall not exceed, in the aggregate, 240 kilotonnes in 1990, 1991, 1992 or 1993.

6. Emissions of sulphur dioxide from the fossil-fuelled electric generating stations of Ontario Hydro shall not exceed, in the aggregate, 175 kilotonnes in any year after 1993.

7. Ontario Hydro shall perform such studies and research as are necessary to determine the options available by which it can meet the limits prescribed in sections 1 to 6.

8.-(1) Ontario Hydro shall file, starting with the 1st day of June, 1987, written reports with the Ministers of Energy and the Environment by the 1st day of March, June, September and December in each year setting out the total of the emissions of sulphur dioxide and nitric oxide from the fossil-fuelled electric generating stations for the three-month period ending on the last day of March, June, September and December immediately before the filing of the report.

(2) Ontario Hydro shall file, starting with the 31st day of July, 1987, written reports with the Ministers of Energy and the Environment by the 31st day of January and July in each year setting out the progress being made for purposes of the limits specified in sections 1 to 6.

(3) If a report with information in sufficient detail so that the Lieutenant Governor in Council can review the options available to Ontario Hydro to meet the limits specified in sections 3 to 6 and the reasoning of Ontario Hydro in selecting

its preferred option to meet those limits has not been filed with the Ministers of Energy and the Environment by the time the report to be filed under subsection (2) by the 31st day of January, 1989, is filed, then that report shall contain such information.

9. Ontario Regulation 662/85 is revoked.

Filed with Registrar
of Regulations: May 25, 1987

Published in
Ontario Gazette: June 13, 1987

Explanatory Note: The original Countdown Acid Rain regulation for Ontario Hydro (O. Reg. 662/85) contained provisions for the "banking" of emissions in certain circumstances. These provisions were removed. The emission limits and dates of implementation were not changed.

ONTARIO REGULATION 663/85

REGULATION MADE UNDER THE ENVIRONMENTAL PROTECTION ACT

ALGOMA SINTER OPERATION - 1986/94

1. Algoma Steel Corporation Limited shall not emit sulphur dioxide from its Sinter Operation at Wawa on any day after its emissions of sulphur dioxide in any calendar year exceed 180 kilotonnes.

2.-(1) Algoma Steel Corporation Limited shall not emit sulphur dioxide from its Sinter Operation at Wawa on any day after its emissions of sulphur dioxide in any calendar year exceed 125 kilotonnes.

(2) This section comes into force on the 1st day of January, 1994.

3. Algoma Steel Corporation Limited shall,

(a) perform such studies and research as are necessary to establish the best available technology and design, and the costs thereof, to assure that the emission limit referred to in section 2 is not exceeded; and

(b) submit written reports to the Minister by the 31st days of January and July in each year starting with the 31st day of July, 1986 to and including the 31st day of July, 1988 on the progress being made on the matters referred to in clause (a).

4. Algoma Steel Corporation Limited shall, by the 31st day of December, 1988, submit to the Minister a final written report of the studies and research referred to in sections 3 in sufficient detail to enable the Lieutenant Governor in Council to assess the methods or plans proposed by Algoma Steel Corporation Limited to meet the limit prescribed by section 2 and the financial assistance, if any, that Algoma Steel Corporation Limited would require to meet that limit.

5. After the 31st day of December, 1988, Algoma Steel Corporation Limited shall submit semi-annual written reports to the Minister on the progress being made in implementing the methods or plans developed for purposes of this regulation.

Filed with Registrar
of Regulations: December 17, 1985

Published in
Ontario Gazette: January 4, 1986

ONTARIO REGULATION 16/86

REGULATION MADE UNDER THE ENVIRONMENTAL PROTECTION ACT

BOILERS

1. In this Regulation,

(a) "ASTM method" means the American Society for Testing Materials standard method of test;

(b) "boiler" means equipment used for the purpose of producing hot water or steam;

(c) "gas" means natural gas, manufactured gas, propane-air gas or any mixture of any of them;

(d) "standard methods of sampling and testing" means,

(i) in the case of fuel oil, ASTM method designated as D-129-60, and

(ii) in the case of coal, ASTM method designated as D3177-75;

(e) "sulphur content" means the average concentration of sulphur in fuel in any ninety day period as determined by standard methods of sampling and testing.

2.-(1) This Regulation applies to every boiler that uses fuel oil or coal as fuel and,

(a) is first put into operation after this Regulation comes into force;

(b) undergoes physical modification so that the ability of the boiler to use fuel is changed;

(c) is put into use after a period of more than twelve months of disuse;

(d) an increase occurs in the sulphur content of the fuel used therein; or

(e) that also uses purchased gas as a fuel where the gas purchase arrangements are modified after this Regulation comes into force so that increased permissible interruptions in the gas supply or any other modifications increase the potential maximum utilization of fuel oil or coal as fuel for the boiler.

(2) This Regulation does not apply,

(a) to boilers at an electric generating station of Ontario Hydro;

(b) to boilers used solely for the purpose of comfort heating in dwellings housing not more than three families; or

(c) to boilers used solely for the purpose of comfort heating in buildings using natural gas or No. 2 oil at a rate less than 1.58 million kilojoules per hour.

3.-(1) No person shall use, in a boiler to which this Regulation applies, fuel oil or coal with a sulphur content in excess of 1 per cent.

(2) Subsection (1) does not apply to a person who has obtained and complies with a certificate of approval under section 8 of the Act for methods or devices than result in emissions to the natural environment of sulphur dioxide no greater than if the fuel had a sulphur content of 1 per cent.

(3) No person shall use, in a boiler to which this Regulation applies, fuel oil or coal with a sulphur content that exceeds the sulphur content that will provide a maximum rate of wet sulphate deposition from the boiler of 0.1 kilograms per hectare per year, in an area set out in the Schedule, as predicted using the Ministry of the Environment Statistical Long Range Transport Model for Air Contaminants.

SCHEDULE

That portion of Ontario, excluding the Counties of Grey and Bruce, bounded on the south by latitude 44° 45' North, on the east by longitude 76° 30' West and on the North by the latitude 50° 00' North.

Filed with Registrar
of Regulations: January 16, 1986